Appendix J

Eelgrass/Macroalgae Survey Report

Eelgrass/Macroalgae Survey Report
Lone Star Gravel Mine
Maury Island, Washington

Prepared for:

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Introduction

Lone Star is proposing to expand levels of mining at its gravel mine on Maury Island, Washington, and to load sand and gravel onto barges from the site (Figure 1). Barge loading would be accomplished using a conveyor system (with a catch tray) and an existing dock. The dock would require replacement of about 30 pilings.

A marine survey completed during January 1998 identified three eelgrass beds and seven small eelgrass patches (<25 square feet each) in the vicinity of the barge loading facility. The purpose of this study is to verify and refine the results of that previous study using Washington Department of Fish and Wildlife (WDFW) guidelines.

Methods

Surveys followed the Eelgrass/Macroalgae Survey Study Plan (JSA 1999) which was based on the intensive survey guidelines provided by WDFW. The study plan was approved by WDFW (Erstad pers. comm.). Survey transects were established in the area surrounding the dock. A total of 19 transects were surveyed within the survey area (Figure 2). Transects are located at the dock centerline, at 10 feet to either side of the centerline, at 40 feet from centerline, and then at approximately every 50 feet. A control site was established northeast of the site, 200 feet from the end of the survey area. This control site will be available for future monitoring.

The following survey prescriptions were used:

Transects

- The diver/biologist surveyed transects perpendicular to the shoreline.
- One transect was located under the centerline of the dock; other transects were spaced 10 feet to either side, then at 40 feet, then at 50-foot intervals.

- Transects reference permanent physical features (distance from pier) and compass heading of each transect. All transects were at 110 degrees (uncorrected for declination) to be parallel with the pier.

- Transects extend from shore to approximately -30 feet mean lower low water (mllw).

Sample Plots for Eelgrass

- Eelgrass turion density was counted at 20-foot intervals along each transect and included the inner and outer margins of the bed.

- At each 20-foot position along the transect, eelgrass turion density was counted at four ¼-meter plots taken at 12, 3, 6,and 9 o'clock positions. Four 1/4-meter plots were also be counted at the beginning and end of each eelgrass bed.

Reconnaissance of Barge Loading Area

- Although the area under the barge loading zone is below the range of eelgrass, a reconnaissance at the end of the pier and dolphins was made to assess and describe the quality of physical and biological conditions of this area. No eelgrass was found in this area.

Sample Plots for Macroalgae

- For macroalgae species, percent cover estimates were conducted along each transect at 20-foot intervals.

- As with eelgrass turion counts, macroalgae percent coverage estimates were taken in four ¼-meter plots at 12, 3, 6, and 9 o'clock positions at each 20-foot position along the transect.

Timing

- Eelgrass/macroalgae surveys were conducted on July 24, 1999 and August 1, 1999.

Reference Points

- Approximate depth contours were established for the project site based on mean lower low water equal to 0.0 (mllw = 0.0). Tidal reference correction used the average tidal prediction for the DesMoines (Lat 47° 24.00'N, Lon 122° 19.70'W) and Tahlequah (Lat 47° 19.90'N, Lon 122° 30.40'W) stations.

Control Area

- Since eelgrass was found in the study area, a control area was established 200 feet from the study area. Three transects were surveyed in the control area according to the prescriptions above. The control area was the only eelgrass bed found along the nearby shoreline, and unfortunately, did not extend through all three transects.

- A steel rod (rebar) was placed at the shoreward end of the control transect 1 (C1) as a semi-permanent reference point.

Results

Survey Conditions

Visibility was good on both days when surveys were completed (July 24 and August 1, 1999). Visibility varied during the day from about 20 feet to about 40 feet. Wave action and current did not interfere with the surveys. On July 24 weather was overcast during the morning, clearing in the afternoon. Weather was clear all day on August 1.

Description of Study Area

The beach adjacent to the Maury Island gravel mine is sand with bands of gravel and cobble material. Generally the intertidal zone (+10 feet to 0 feet mllw elevation) has an even slope of about 10 %. An area of the beach from about 100 feet south of the pier to about 400 feet north of the pier, and about 80 feet to 100 feet from the headland, appears to have had some deposition of sand. A band of gravel and cobble material extends across the beach at about the +9 feet to +5 feet (mllw) elevation, probably the result of natural sorting since this band receives more wave action on average than areas above or below. Substrate at elevations less than +5 feet (mllw) is generally sand, with the exception of areas under the dock and around pilings that are covered with shell debris in some locations, a mound of sand and gravel substrate at the end of the pier, and local accumulations of wood pieces. The wood was probably once part of two wooden barges that sank south of the pier and dolphins. The mound of sand and gravel at the end of the pier appears to be from spillage during previous barge loading activity at the site. The locations of survey transects, substrate types, depth contours and eelgrass distribution are shown in Figure 2.

Habitat and Species Observed

The aquatic habitat at the site is diverse with bare sand areas, eelgrass beds, and areas associated with the pier. One aquatic plant (eelgrass), six varieties (taxa) of algae, 22 invertebrate species, and 20 fish species were observed (Table 1). Schools of shiner perch hovered over the eelgrass beds, and large schools of Pacific sand lance swam over the intertidal and nearshore subtidal areas during our surveys.

Eelgrass Distribution and Density

Eelgrass distribution was patchy (Figure 2). Small eelgrass patches, individual turions, and a few larger beds were found at the site. Eelgrass was generally found at –5 feet to –15 feet mllw, with a few individual plants or small patches at higher elevations (Table 2). The deepest extent of eelgrass found was at -15.9 feet mllw.

Average eelgrass density was low to moderate, ranging from single plants to 22.9 turions per 0.25 square meter. Data from each transect are presented in Appendix A. By comparison, at least one location on Whidbey Island has representative density counts of over 200 vegetative shoots per 0.25 square meter (Phillips 1984). However, average densities of less than 20 turions per 0.25 square meter are representative of other locations on Whidbey Island, Grays Harbor, and Hood Canal (Phillips 1984).

Macroalgae Distribution and Density

One kelp species (*Laminaria saccharina*), and two green algae (*Ulva lactuca* and *Enteromorpha* sp.) were common throughout the lower elevation areas. Some red algae were also found. *Laminaria* was common at depths below –20 feet mllw. Macroalgae was not found in extensive beds, but coverage was considerable in some locations. Percent cover by plot is shown in Appendix A. Coverage of 100% by *Laminaria* is common since each blade can cover 0.5 square meter or more. No bull kelp or giant kelp was found at the site.

Description of Barge Loading Area

A mound of sand and gravel at the end of the conveyor raises the bottom above the surrounding area by about 2 feet. Beyond the mound, the sand and gravel appears to have moved southeast since the bathymetry slopes off most gradually in that direction. *Laminaria* is common in the area. Flatfish were abundant in this area, as were copper rockfish, brown rockfish, and pile perch. White and orange plume anemones covered pilings, and shell and barnacle fragments accumulated along the edge of the pilings. Piddock and geoduck clams were found in the area, although

they were most abundant directly under the pier. Sunflower stars, leather stars, sun stars and short-spined stars were all found in the area.

Threatened and Endangered Species

One federally listed threatened species, chinook salmon, was seen in the project area and control site. Two candidate species, copper rockfish and brown rockfish, were also seen near the dock pilings and barge loading area.

Recommendations for Future Monitoring

If dock repairs and barge loading are undertaken at the site, monitoring of eelgrass distribution and density may be required by WDFW as a condition of a Hydraulic Project Approval (HPA) Permit for in-water work. This study was designed to provide a baseline of information to support future monitoring studies. Because eelgrass density may change from one year to the next due to large-scale environmental changes, measurements from the control site can be used to assess whether eelgrass density in the study area has remained consistent.

The distribution of eelgrass is patchy at this site, and eelgrass bed locations may shift somewhat from year to year. Therefore, aerial photography during a very low tide may be the best way to document eelgrass coverage by area. Ideally aerial photos would be taken in June or July when the sun angle is high and eelgrass has grown to the fullest extent. This method has been used successfully at another Puget Sound location of similar size to determine the stability of eelgrass beds (Jones & Stokes Associates 1996).

Citations

Erstad, Pam. Marine habitat biologist. Washington Department of Fish and Wildlife, Mill Creek, WA. June 1999 – telephone conversation.

[JSA] Jones & Stokes Associates. 1999. Maury Island, WA. Lone Star Gravel Mine. Eelgrass/macroalgae survey study plan. July 2. Bellevue, WA.

_____. 1996. Elliott Bay Marina, Puget Sound, Washington. Final 1995 eelgrass monitoring report. March 4. (JSA 95-142.) Bellevue, WA. Prepared for Elliott Bay Marina, Inc. Seattle, WA.

Phillips, R. L. 1984. Ecology of eelgrass meadows in the Pacific Northwest: A community profile. (FWS/OBS-84/24. PB86-110376.) Seattle Pacific University, Seattle, WA. Prepared for U.S. Fish and Wildlife Service.

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Table 1. Marine Algae, Plant, and Animal Species Observed Adjacent to the Maury Island Gravel Mine Site

Major Taxa	Common Name	Scientific Name	Abundance	Notes
Algae	Diatoms	*Bacillariophyceae*	Common	Common on sand at about -5' mllw
	Kelp	*Laminaria saccharina*	Common	Common at -10' to -30' mllw
	Red Algae	*Rhodophyta*	Occasional	
	Thin Red Algae	*Gracilaria* sp.	Occasional	
	Sea Lettuce	*Ulva lactuca*	Common	Drift *Ulva* between +5' and 0 mllw, attached *Ulva* below 0 mllw
		Enteromorpha sp.	Common	Drift *Enteromorpha* between +5' and 0 mllw, attached between 0 and -5' mllw
Plants	Eelgrass	*Zostera marina*	Common	In patches and small beds generally between -5' and -16' mllw
Hydrozoa (jellyfish)	Lion's Mane Jellyfish	*Cyanea* sp.	1	On transect S-3
Anthozoa (anemones)	Plume Anemone	*Metridium* sp.	Common	Common on pilings; orange and white varieties
Mollusks	Geoduck Clam	*Panopea generosa*	Occasional	Common under the pier, occasionally found elsewhere; found below -15' mllw
	Piddock Clam	*Pholadidae*	Occasional	Common under the pier, occasionally found elsewhere; found below -15' mllw
	Heart Cockle	*Clinocardium nutalii*	Occasional	
	Bay Mussel	*Mytilus edulis*	Common	On pilings
	Octopus	*Octopus* sp.	1	On transect N-8
Worms	Plume Worms	*Sabellidae*	Occasional	On pilings
	Tube Worms	*Polychaeta.*	Common	In sand at about -2' mllw
Shrimp	Broken-back Shrimp	*Crangonidae*	1	On control transect C-1
Crabs	Dungeness Crab	*Cancer magister*	Occasional	
	Graceful Crab	*Cancer gracilis*	Occasional	In eelgrass beds
	Red Rock Crab	*Cancer productus*	Few	
	Northern Kelp Crab	*Pugettia producta*	Occasional	
	Helmet Crab	*Telmessus cheiragonus*	Occasional	In control area eelgrass bed, transect C-1
	Hermit Crab	*Pagurus* sp.	Occasional	
Barnacles	Acorn Barnacle	*Balanus* sp.	Common	On cobbles, boulders, and pilings +10 to +5 mllw

Table 1. Continued

Major Taxa	Common Name	Scientific Name	Abundance	Notes
Sea Stars	Sunflower Star	*Pycnopodia helianthoides*	Common	At depths below -20 mllw
	Sunstar	*Solaster dawsoni*	Common	
	Short-spined Sea Star	*Pisaster brevispinus*	Occasional	At depths below -20 mllw
	Rose Star	*Crossaster pappofus*	1	On transect N-6
	Leather Star	*Dermasterias imbricata*	Occasional	At depths below -20 mllw
Fish	Shiner Perch	*Cymatogaster aggregata*	Common	Especially common in eelgrass
	Pile Perch	*Rhacocheilus vacca*	Common	Near pilings
	Brown Rockfish	*Sebastes auriculatus*	Common	Near pilings
	Copper Rockfish	*Sebastes caurinus*	Occasional	Near pilings
	English Sole	*Parophrys vetulus*	Common	
	C-O Sole	*Pleuronichthys stellatus*	Occasional	
	Starry Flounder	*Platichthys stellatus*	Occasional	
	Sand Dab	*Citharichthys* sp.	Occasional	
	Crescent Gunnel	*Pholis laeta*	Common	In eelgrass
	Sand Lance	*Ammodytes hexapterus*	Abundant	Large schools
	Tubesnout	*Aulorhynchus flavidus*	Common	
	Cabezon	*Scorpaenichthys marmoratus*	1	
	Buffalo Sculpin	*Enophrys bison*	Occasional	
	Sculpin (other unidentified)	Various species	Common	
	Ratfish	*Hydrolagus colliei*	1	On transect N-6
	Chinook Salmon	*Oncorhynchus tshawytscha*	Occasional	Age 0+, two on transect S-3, one on C-1, one on C-2
	Snake Prickleback	*Lumpenus sagitta*	1	On transect S-5
	Painted greenling	*Oxylebius pictus*	1	
	White-spot Greenling	*Hexagrammos stelleri*	2	On transects S-7 and S-9
	Spiny dogfish	*Squalus acanthias*	1	On transect C-2

Table 2. Eelgrass Density Statistics by Bed

Transect	Distance	Average Density (turions/0.25m²)	Standard Deviation of Density (turions/0.25m²)	Number of Samples/Bed[1]	Depth (feet mllw)	Notes
0	192	4	3.55	3		0.75 m² patch
N1	190-209	12.9	8.82	12	-6.5 to -9.4	
N2						No eelgrass found
N3	204	1		1	-19.6	Single turion south of transect
N4	73	20		1	+5.1	1.4' x 1.2' patch at sand/gravel boundary
N4	200	1		1	-11.7	Single turion
N5	168	1		1	-9.6	Single turion 10' north of transect
N5	185	1		1	-15	Single turion 10' north of transect
N6						No eelgrass found
N7	84	2		1	+4.8	Two turions 5' north of transect
N7	209-271	13.2	8.88	17	-3.7 to -14.6	
Between N7&N8	221				-10	0.25 m² patch
Between N7&N8	235				-13	10' x 7' patch
N8						No eelgrass found
N9						No eelgrass found
S1						No eelgrass found
S2						No eelgrass found
S3						No eelgrass found
S4	208	12		1	-7.3	0.25 m² patch
S5						No eelgrass found
S6	164	9		1	-1.1	0.25 m² patch
S6	204-258	16.6	12.8	13	-4.4 to -15.5	
S7	208-214	19.6	2.97	7	-5.3 to -11.5	
S8						No eelgrass found
S9						No eelgrass found
C1	195-210	22.9	6.57	8	-6.2 to -6.5	
C1	233-304	14.5	8.81	17	-6.6 to -15.9	
C2	175-181	15	14.64	4	-2.7 to -3.6	
C2	197-295	13.6	13.3	26	-5.5 to -14.6	
C3						No eelgrass found

Notes:
[1] Plots at bed margins with 0 counts were not included in bed density averages.

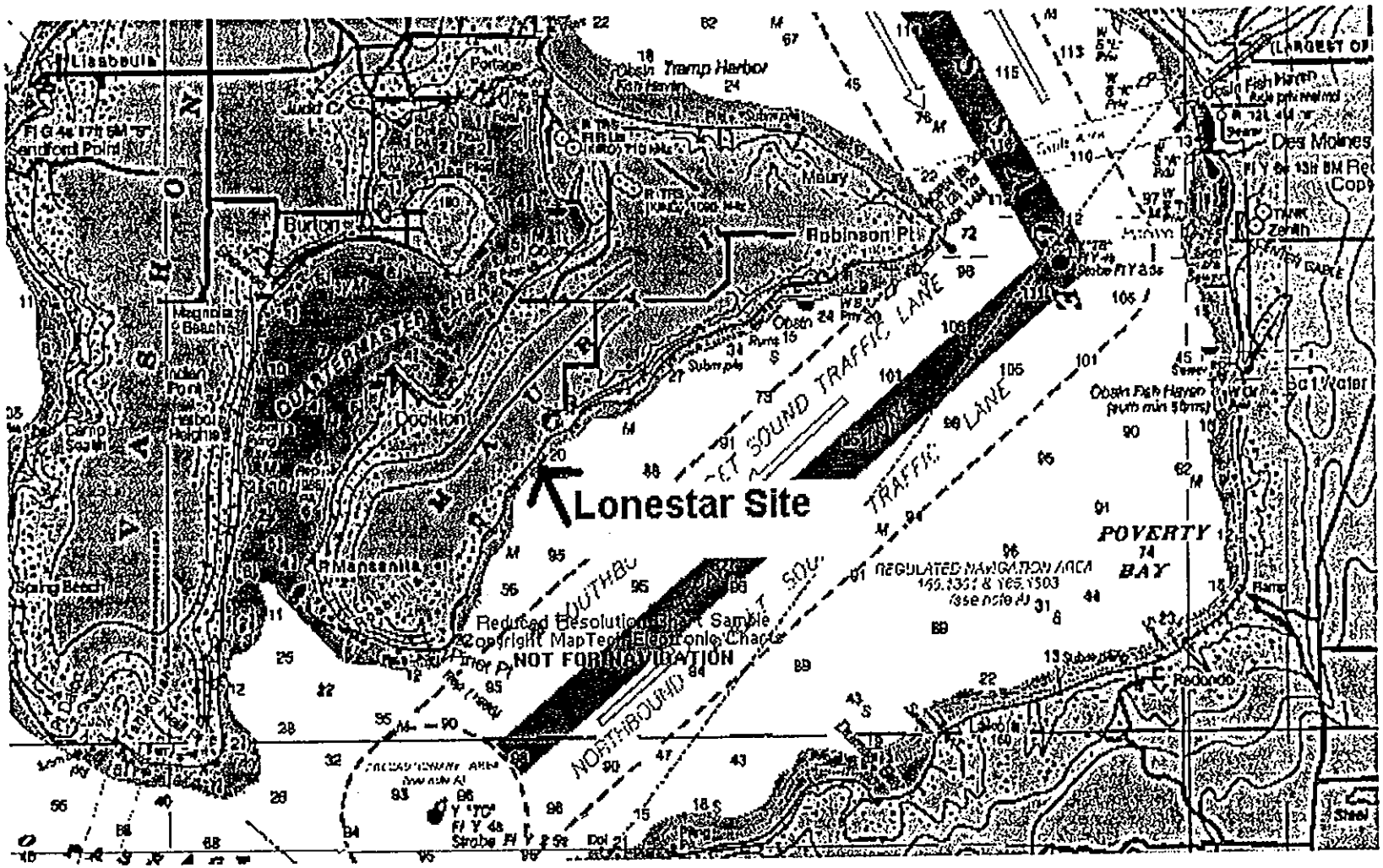

Figure 1. Location of the Lone Star Gravel Mine Site, Maury Island, WA

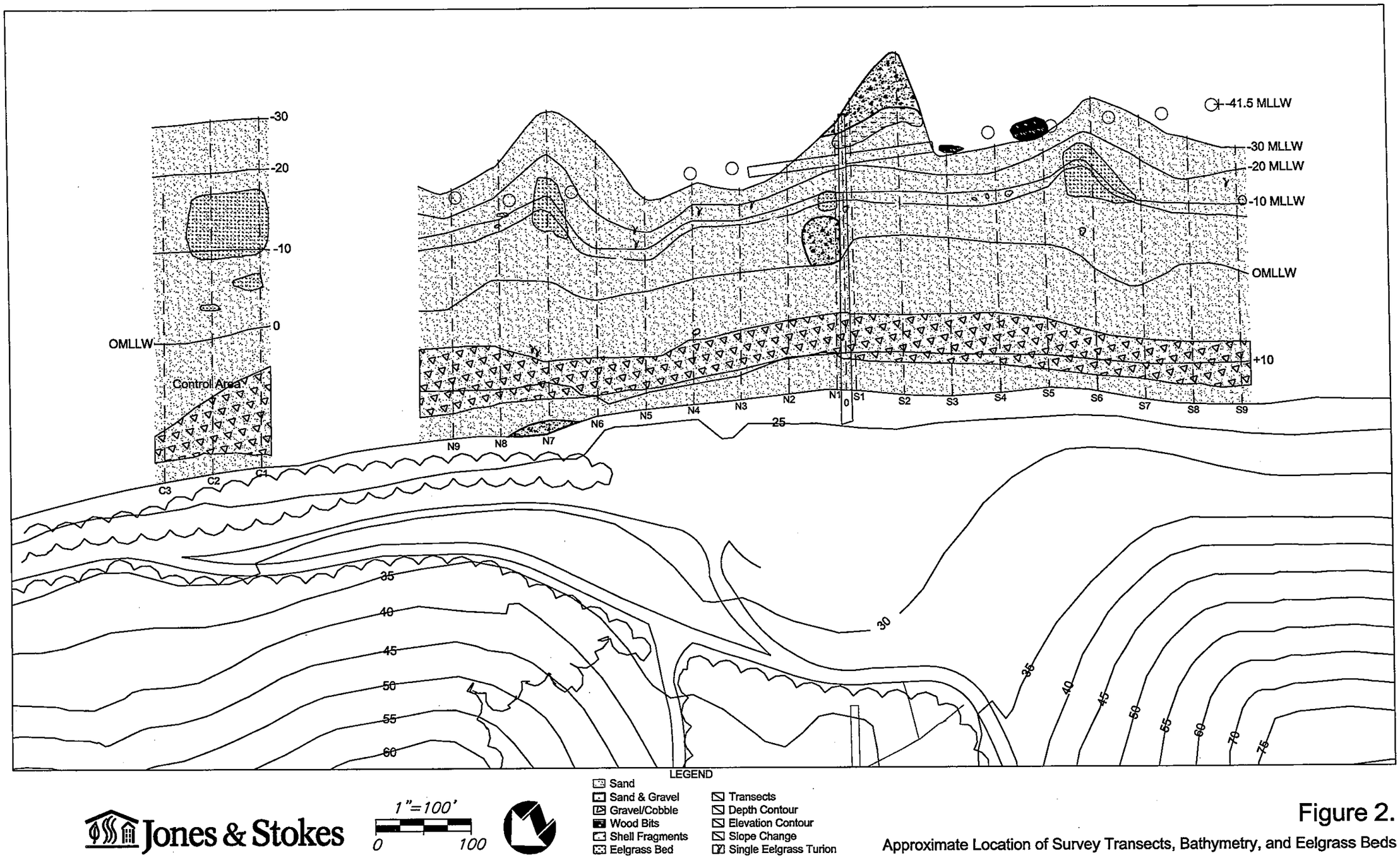

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Figure 2.

Approximate Location of Survey Transects, Bathymetry, and Eelgrass Beds

Appendix A
Eelgrass/Macroalgae Survey Forms

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Intensive Eelgrass / Macroalgae Survey Form

Date: 07/24/99

Transect#: 0 (pier centerline)
Visibility: 20'
Location: Pier centerline
Heading: 110

Compass Declination: 0
Surveyor: A. Wones

Project: King County / Maury Island Gravel Mine
Survey Level Elevation 15.55

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	base of bank	0	0	0	0	0	0	sand		2.5	1048	13.1
20		0	0	0	0	0	0	sand		4.5		11.1
37		0	0	0	0	0	0	sand & gravel		6.3		9.3
40		0	0	0	0	0	0	sand & gravel		6.7		8.9
60		0	0	0	0	0	0	sand & gravel		8.7		6.9
80		0	0	0	0	0	0	sand & gravel		10.5	10:53	5.1
85	rise in sand elevation	0	0	0	0	0	0	sand		10.5		5.1
97	drift Ulva	10%	5%	5%	15%	0.088	0.041	sand		11.5		4.1
100	drift Ulva	5%	0	0	0	0.013	0.022	sand		11.7		3.9
120		0	0	0	0	0	0	sand & gravel		13.4		2.2
132		0	0	0	0	0	0	sand	0	14.2	11:00	1.4
152	*Ulva*	0	0	0	1%	0.003	0.004	sand	10		14:44	-1.3
169		0	0	0	0	0	0	gravel	11		14:48	-2.2
172	worm tubes	0	0	0	0	0	0	sand	11		14:45	-2.3
179		0	0	0	0	0	0	sand				
192	eelgrass patch	1	9	2	0	3	3.536	sand	15		14:54	-6.1
198	slopebreak, eelgrass north of pier	0	0	0	0	0	0	sand				
212	*Laminaria*	100%	100%	100%	50%	0.875	0.217	sand				
232	Ulva	0	5%	10%	0	0.038	0.041	shell fragments	30		15:04	-20.9
252	mound of gravel/sand; Laminaria ~50%							sand & gravel	~-28			~-19
290	gravel/sand; Laminaria ~50%							sand & gravel	40		~15:05	-30.9

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 07/24/99

Transect#: N1
Visibility:
Location: 10' N of Pier
Heading: 110

Compass Declination: 0
Surveyor: A. Wones

Project: King County / Maury Island Gravel Mine
Survey Level Elevation 15.575

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0		0	0	0	0	0	0	sand		1.4	11:06	14.2
20		0	0	0	0	0	0	sand		4.6		11.0
33	boulders/barnacles	0	0	0	0	0	0	sand&gravel		6		9.6
40		0	0	0	0	0	0	sand&gravel		6.8		8.8
60		0	0	0	0	0	0	sand&gravel		8.8		6.8
80	barnacles end	0	0	0	0	0	0	sand		10.6		5.0
93	drift Ulva	10%	0%	5%	10%	0.063	0.041	sand		11.3		4.3
100	drift Ulva	5%	5%	10%	<5%	0.05	0.035	sand		11.9		3.7
120		0	0	0	0	0	0	sand&gravel		13.5		2.1
124		0	0	0	0	0	0	sand&gravel	0	13.8	11:15	1.8
144	Ulva on rock	50%	0	0	0	0.125	0.217	sand/boulder	10.5		15:11	-1.2
164		0	0	0	0	0	0	sand&gravel	12		15:13	-2.7
184	diatoms on sand	0	0	0	0	0	0	sand	15		15:15	-5.6
190	eelgrass	29	4	24	17	18.5	9.394	sand	16		15:19	-6.5
199	eelgrass	22	21	21	14	19.5	3.202	sand	18		15:24	-8.5
204	eelgrass	10	15	12	11	12	1.871	sand	19		15:29	-9.4
204	*Laminaria*	100%	30%	0%	0%	0.325	0.409	sand	19		15:29	-9.4
204	red alga	0%	0%	0%	25%	0.063	0.108	sand	19		15:29	-9.4
206	slope break	0	0	0	0	0	0	sand	19		15:32	-9.4
209	end of eelgrass bed	7	0	0	0	1.75	3.031	sand	19.5		15:31	-9.9
224	*Laminaria*	0%	25%	0%	0%	0.063	0.108	sand	25		15:36	-15.2
244	*Laminaria*	25%	0%	0%	0%	0.063	0.108	sand	30		15:40	-20.2
244	red alga	0%	1%	0%	0%	0.003	0.004	sand	30		15:40	-20.2
244	Laminaria	25%	0%	0%	0%	0.063	0.108	sand	30		15:40	-20.2
164		0	0	0	0	0	0	sand	36		~15:45	-26.1
244		0	0	0	0	0	0	sand	40		~15:45	-30.1

Comments: 15 piddock clams, 12 geoduck clams
* Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 07/24/99

Transect#: N2
Visibility: 20 to 30 feet
Location: 50' N of Pier
Heading: 110

Compass Declination: 0
Surveyor: A. Wones

Project: King County / Maury Island Gravel Mine
Survey Level Elevation 15.45

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	headland	0	0	0	0	0	0	sand		2.7	11:25	12.8
20		0	0	0	0	0	0	sand		4.4		11.1
37		0	0	0	0	0	0	sand/gravel		6.4		9.1
40		0	0	0	0	0	0	sand/gravel		6.7		8.8
60		0	0	0	0	0	0	gravel/sand		8.9		6.6
80	drift Ulva	0%	5%	0%	5%	0.025	0.025	sand		10.7		4.8
100	drift Ulva	5%	5%	5%	5%	0.05	0	sand		11.9		3.6
105	drift Ulva ends	<5%	<5%	5%	<5%	0.013	0.022	sand		12.5		3.0
116		0	0	0	0	0	0	sand		13.3	11:32	2.2
116		0	0	0	0	0	0	sand/pea gravel	9.5		16:20	0.8
136		0	0	0	0	0	0	sand	10.5		16:21	-0.2
156		0	0	0	0	0	0	sand	12		16:23	-1.7
170		0	0	0	0	0	0	sand				
176		0	0	0	0	0	0	sand	15		16:25	-4.7
193	slope break	0	0	0	0	0	0	sand				
196		0	0	0	0	0	0	gravel/sand	19		16:27	-8.7
216	red alga	0%	0%	10%	0%	0.025	0.043	sand	30		16:29	-19.7
236		0	0	0	0	0	0	shell fragments	40		16:30	-29.7

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 07/24/99

Transect#: N3
Visibility: 20 to 30 feet
Location: 100' N of Pier
Heading: 110

Compass Declination: 0
Surveyor: A. Wones

Project: King County / Maury Island Gravel Mine
Survey Level Elevation 15.6

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	headland	0	0	0	0	0	0	sand		2.6	11:38	13.0
20		0	0	0	0	0	0	sand		4.6		11.0
35		0	0	0	0	0	0	sand/gravel		6.6		9.0
40	barnacles	0	0	0	0	0	0	sand/gravel		7.2		8.4
60	barnacles	0	0	0	0	0	0	sand/gravel		9.4		6.2
73	drift Ulva	5%	20%	10%	5%	0.1	0.061	sand/gravel		10.8		4.8
77	drift Ulva; slope break	5%	5%	0%	0%	0.025	0.025	sand		10.7		4.9
80		0	0	0	0	0	0	sand		10.7		4.9
89	drift Ulva	5%	5%	5%	0%	0.038	0.022	sand		10.6		5.0
100	drift Ulva	<5%	<5%	<5%	0%	0	0	sand		11.3		4.3
104		0	0	0	0	0	0	sand		12.3		3.3
104		0	0	0	0	0	0	sand	8	12.8	11:47	2.8
124		0	0	0	0	0	0	sand	10		16:51	0.4
144		0	0	0	0	0	0	sand	11		16:53	-0.6
164		0	0	0	0	0	0	sand/gravel	12		16:54	-1.6
183	Slope break	0	0	0	0	0	0	sand	17.5		16:57	-7.1
184		0	0	0	0	0	0	sand	18		17:04	-7.6
204	*Laminaria*	0%	5%	5%	1%	0.028	0.023	sand	30		17:04	-19.6
224		0	0	0	0	0	0	sand	40		17:05	-29.6

Comments: Macroalgae in %, eelgrass in turion counts
1 turion south of transect at depth of -19.6'mllw.
* Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 07/24/99

Transect#: N4
Visibility: 20 to 30 feet
Location: 150' N of Pier
Heading: 110

Compass Declination: 0
Surveyor: A. Wones

Project: King County / Maury Island Gravel Mine
Survey Level Elevation 15.45

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	headland	0	0	0	0	0	0	sand/gravel		2.5		13.0
20		0	0	0	0	0	0	sand		5.1		10.4
35		0	0	0	0	0	0	sand/gravel		7.5		8.0
40	drift Ulva	0%	0%	5%	5%	0.025	0.025	sand/gravel		7.6		7.9
60	drift Ulva	5%	0%	0%	0%	0.013	0.022	gravel/sand		9.8		5.7
69	drift Ulva; slope change	<5%	40%	10%	5%	0.138	0.156	sand/gravel		10.7		4.8
73	eelgrass patch 1.4' X 1.2'	20	0	0	0	5	8.66	sand		10.4		5.1
80	drift Ulva	0%	0%	0%	10%	0.025	0.043	sand		11		4.5
94	drift Ulva	0%	0%	0%	10%	0.025	0.043	sand		12.3	12:02	3.2
94		0	0	0	0	0	0	sand	8		17:15	2.4
114		0	0	0	0	0	0	sand	9		17:17	1.4
134		0	0	0	0	0	0	sand	10.5		17:18	-0.1
154	*Enteromorpha*	0	0	0	0	0	0	sand	12		17:20	-1.6
174	tube worms	0	0	0	0	0	0	sand	14		17:22	-3.6
188	slope break	0	0	0	0	0	0	sand	18		17:24	-7.6
194		0	0	0	0	0	0	sand	20		17:26	-9.7
200	1 eelgrass turion	1	0	0	0	0.25	0.433	sand	22		17:26	-11.7
210		0	0	0	0	0	0	sand	30		17:28	-19.7
220	*Laminaria*	100%	0%	100%	0%	0.5	0.5	sand	40		17:30	-29.7

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 07/24/99

Transect#: N5
Visibility:
Location: 200' N of Pier
Heading: 110

Compass Declination: 0
Surveyor: G. Volkhardt

Project: King County / Maury Island Gravel Mine
Survey Level Elevation 14.775

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	base of riprap	0	0	0	0	0	0	sand		3.7		11.1
20		0	0	0	0	0	0	sand/gravel		6.2		8.6
40		0	0	0	0	0	0	gravel/sand		8.5		6.3
52	slope change; Enteromorpha	5%	10%	0%	5%	0.05	0.035	sand/gravel		9.6		5.2
56	top of sand deposit	0	0	0	0	0	0	sand		9.6		5.2
60		0	0	0	0	0	0	sand		9.9		4.9
68		0	0	0	0	0	0	sand		10.7	12:24	4.1
68		0	0	0	0	0	0	sand	4		14:25	4.2
88		0	0	0	0	0	0	sand	5			3.2
108		0	0	0	0	0	0	sand	7			1.3
128	*Ulva*	0%	0%	0%	20%	0.05	0.087	sand	9		~14:30	-0.7
148		0	0	0	0	0	0	sand	12			-3.7
158	slope break	0	0	0	0	0	0	sand	13			-4.6
168	1 eelgrass turion 10' north	0	0	0	0	0	0	sand	18		~14:35	-9.6
185	1 eelgrass turion 10' north	0	0	0	0	0	0	sand				
188		0	0	0	0	0	0	sand	28			-19.5
208	*Ulva*	5%	5%	5%	5%	0.05	0	sand	36			-27.5
208	*Laminaria*	10%	0%	0%	0%	0.025	0.043	sand	36			-27.5
228	*Ulva*	30%	20%	10%	30%	0.225	0.083	sand	42		~14:40	-33.4

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 07/24/99

Transect#: N6
Visibility:
Location: 250' N of Pier
Heading: 110

Compass Declination: 0
Surveyor: G. Volkhardt

Project: King County / Maury Island Gravel Mine
Survey Level Elevation 14.6

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	base of beach logs	0	0	0	0	0	0	sand		4.3		10.3
14		0	0	0	0	0	0	sand/gravel		6		8.6
20		0	0	0	0	0	0	sand/gravel		6.8		7.8
40		0	0	0	0	0	0	sand/gravel		9.1		5.5
46		0	0	0	0	0	0	sand		9.7		4.9
55		0	0	0	0	0	0	sand		10.2	12:35	4.4
55		0	0	0	0	0	0	sand	4		14:48	4.8
75		0	0	0	0	0	0	sand	5		~14:50	3.8
95		0	0	0	0	0	0	sand	7		~14:52	1.9
115		0	0	0	0	0	0	sand	8		~14:54	1.0
135	diatoms	0	0	0	0	0	0	sand	10		~14:56	-1.0
155	diatoms	0	0	0	0	0	0	sand	12		~14:58	-2.9
170	slope break; Enteromorpha	<5%	<5%	<5%	<5%	0	0	sand	14		~15:00	-4.9
175	*Enteromorpha*	25%	10%	5%	5%	0.113	0.082	sand	16		~15:02	-6.9
195	*Ulva*	5%	25%	10%	5%	0.113	0.082	sand	25		~15:04	-15.8
215	*Ulva*	70%	60%	50%	50%	0.575	0.083	sand	31		~15:06	-21.8
235	*Ulva; piling 10' North*	5%	10%	5%	5%	0.063	0.022	shell fragments	33		~15:08	-23.7
255	*Laminaria*	30%	5%	0%	0%	0.088	0.124	shell fragments	36		~15:10	-26.7
275	diatoms	0	0	0	0	0	0	sand	38		~15:12	-28.7
295	*Laminaria*	60%	50%	0%	0%	0.275	0.277	sand	40		15:13	-30.6

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 07/24/99

Transect#: N7
Visibility:
Location: 300' N of Pier
Heading: 110

Compass Declination: 0
Surveyor: G. Volkhardt

Project: King County / Maury Island Gravel Mine
Survey Level Elevation 16.15

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	headland	0	0	0	0	0	0	sand/gravel		3	12:42	13.2
20		0	0	0	0	0	0	sand		5.2		11.0
40		0	0	0	0	0	0	sand/gravel		7.5		8.7
60		0	0	0	0	0	0	sand/gravel		9.5		6.7
77	slope change	0	0	0	0	0	0	sand		11.4		4.8
84	2 eelgrass turions 5' north	0	0	0	0	0	0	sand		11.4	12:47	4.8
84		0	0	0	0	0	0	sand	4		16:02	6.1
104		0	0	0	0	0	0	sand	6		16:05	4.1
124		0	0	0	0	0	0	sand	7		16:08	3.2
144		0	0	0	0	0	0	sand	9		16:11	1.2
164		0	0	0	0	0	0	sand	10		16:14	0.2
184	*Enteromorpha*	5%	<5%	<5%	<5%	0.013	0.022	sand	12		16:17	-1.7
204		0	0	0	0	0	0	sand	13		16:20	-2.7
209	eelgrass	22	7	9	23	15.25	7.293	sand	14		16:25	-3.7
224	eelgrass	23	27	23	23	24	1.732	sand	16		16:30	-5.7
244	eelgrass	12	13	18	13	14	2.345	sand	18		16:35	-7.6
264	eelgrass	3	3	2	1	2.25	0.829	sand	23		16:38	-12.6
271	eelgrass	0	0	0	2	0.5	0.866	sand	25		16:40	-14.6
284	*Laminaria*	20%	0%	60%	30%	0.275	0.217	sand	27		16:43	-16.6
304	*Laminaria*	30%	25%	0%	0%	0.138	0.139	sand	32		16:46	-21.6
324	*Gracilaria*	5%	0%	0%	0%	0.013	0.022	sand	37		16:49	-26.6
344		0	0	0	0	0	0	sand	41		16:51	-30.6

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 07/24/99

Transect#: N8
Visibility:
Location: 350' N of Pier
Heading: 110

Compass Declination: 0
Surveyor: G. Volkhardt

Project: King County / Maury Island Gravel Mine
Survey Level Elevation 16.7

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	base of bank/beach log	0	0	0	0	0	0	gravel		3.6	12:55	13.1
20		0	0	0	0	0	0	sand		5.3		11.4
35		0	0	0	0	0	0	sand/gravel		6.9		9.8
40		0	0	0	0	0	0	gravel/sand		7.7		9.0
60		0	0	0	0	0	0	gravel/sand		9.7		7.0
75		0	0	0	0	0	0	gravel/sand		11.4	12:59	5.3
75		0	0	0	0	0	0	gravel/sand	4		16:50	6.4
95		0	0	0	0	0	0	sand	4			6.4
115	7' north of cable anchor	0	0	0	0	0	0	sand	7			3.4
135		0	0	0	0	0	0	sand	8			2.4
155		0	0	0	0	0	0	sand	10			0.4
175		0	0	0	0	0	0	sand	11			-0.6
195		0	0	0	0	0	0	sand	13			-2.6
215	slope break; Enteromorpha	5%	5%	5%	5%	0.05	0	sand	16			-5.6
235		0	0	0	0	0	0	sand	23			-12.6
255	Laminaria	60%	100%	10%	10%	0.45	0.377	sand	32			-21.6
275	Ulva	10%	10%	15%	0%	0.088	0.054	sand	38			-27.6
275	Laminaria	30%	30%	15%	40%	0.288	0.089	sand	38			-27.6
295		0	0	0	0	0	0	sand	43		17:10	-32.6

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.
At 221' there is a 0.25 square meter patch of eelgrass 3' south of the transect.
At 235' there is a 10'X7' patch of eelgrass 5' south of the transect.

Intensive Eelgrass / Macroalgae Survey Form

Date: 07/24/99(above water); 08/01/99(un

Transect#: N9
Visibility:
Location: 400' N of Pier
Heading: 110

Compass Declination: 0
Surveyor: A. Wones

Project: King County / Maury Island Gravel Mine
Survey Level Elevation 16.9

Distance (feet)	Observation	Eelgrass Density/ 0.25 m2 R1	R2	R3	R4	Ave.	Std.	Macroalgae % cover Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	Headland	0	0	0	0	0	0	sand		3.6	13:03	13.3
20		0	0	0	0	0	0	sand		5.1		11.8
28		0	0	0	0	0	0	cobble/sand				
35		0	0	0	0	0	0	cobble/sand		7		9.9
40		0	0	0	0	0	0	cobble/sand		7.5		9.4
60		0	0	0	0	0	0	cobble/sand		9.5		7.4
74		0	0	0	0	0	0	cobble/sand		11	13:06	5.9
80	barnacles	0	0	0	0	0	0	cobble/sand				
88	end of cobble band	0	0	0	0	0	0	sand				
100		0	0	0	0	0	0	sand	1.8		17:46	4.9
120		0	0	0	0	0	0	sand	4.1		17:49	2.9
140		0	0	0	0	0	0	sand	8		17:53	-0.8
160		0	0	0	0	0	0	sand	9		17:54	-1.8
180		0	0	0	0	0	0	sand/gravel	10.5		17:56	-3.3
200		0	0	0	0	0	0	sand	12		17:57	-4.6
206		0	0	0	0	0	0	sand	13		17:59	-5.6
220		0	0	0	0	0	0	sand	20		18:01	-12.6
240	*Ulva*	5%	0%	5%	5%	0.038	0.022	sand	30		18:03	-22.4
260	*Ulva*	5%	10%	5%	5%	0.063	0.022	sand	38		18:05	-30.4
260	*Laminaria*	0%	10%	0%	0%	0.025	0.043	sand	38		18:05	-30.4

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 08/01/99

Transect#: S1
Visibility:
Location: 10' S of pier centerline
Heading: 110

Compass Declination: 0
Surveyor: A. Wones

King County / Maury Island Gravel Mine

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	Headland	0	0	0	0	0	0	sand				
20		0	0	0	0	0	0	sand				
27		0	0	0	0	0	0	sand/gravel				
40		0	0	0	0	0	0	sand/gravel				
60		0	0	0	0	0	0	sand/cobble				
80	rise in sand elevation	0	0	0	0	0	0	sand				
100		0	0	0	0	0	0	sand				
103		0	0	0	0	0	0	sand/gravel				
120		0	0	0	0	0	0	sand/gravel				
140		0	0	0	0	0	0	sand/gravel				
141		0	0	0	0	0	0		0		13:11	1.2
160		0	0	0	0	0	0		0.5		13:55	-0.1
180		0	0	0	0	0	0		2.4		13:57	-2.0
200	top of slope change	0	0	0	0	0	0		4.4		14:00	-4.0
220	*Laminaria*	50%	100%	100%	100%	0.875	0.217	coarse sand	15		14:09	-14.7
240	*Laminaria*	20%	5%	10%	5%	0.1	0.061	and/metal/woo	21		14:10	-20.7
240	*Ulva*	0%	5%	20%	0%	0.063	0.082	and/metal/woo	21		14:10	-20.7
260	*Laminaria*	80%	30%	75%	50%	0.588	0.201	shell fragments	29		14:15	-28.7
260	*Ulva*	0%	20%	0%	10%	0.075	0.083	shell fragments	29		14:15	-28.7
260	red alga	0%	20%	0%	0%	0.05	0.087	shell fragments	29		14:15	-28.7
280	*Laminaria*	0%	40%	15%	5%	0.15	0.154	shell fragments	28		14:20	-27.7
280	*Ulva*	5%	0%	0%	5%	0.025	0.025	shell fragments	28		14:20	-27.7
280	red alga	0%	5%	0%	10%	0.038	0.041	shell fragments	28		14:20	-27.7
300	*Laminaria*	0.5	10%	10%	10%	0.2	0.173	sand/gravel	31		14:23	-30.7

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 08/01/99

Transect#: S2
Visibility:
Location: 50' S of pier centerline
Heading: 110

Compass Declination: 0
Surveyor: G. Volkhardt

Project: King County / Maury Island Gravel Mine

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0		0	0	0	0	0	0					
20		0	0	0	0	0	0					
40		0	0	0	0	0	0					
60		0	0	0	0	0	0					
80		0	0	0	0	0	0					
100		0	0	0	0	0	0					
120		0	0	0	0	0	0					
140		0	0	0	0	0	0					
160	*Enteromorpha*	5%	0	0	0	0.013	0.022	sand	2		12:30	0.3
180	*Enteromorpha*	<5%	<5%	5%	5%	0.025	0.025	sand	3			-0.8
200	break in slope; Enteromorpha	<5%	<5%	0	<5%	0	0	sand	6			-3.9
220		0	0	0	0	0	0	sand	14		12:40	-12.0
240	*Ulva*	5%	10%	5%	5%	0.063	0.022	sand	23			-21.1
260	base of piling; Laminaria	20%	50%	30%	20%	0.3	0.122	sand	28			-26.2
260	*Ulva*	5%	5%	5%	5%	0.05	0	sand	28			-26.2
260	red algae	0%	10%	10%	0%	0.05	0.05	sand	28			-26.2
280	*Ulva*	0%	5%	5%	5%	0.038	0.022	shell fragments	28			-26.3
300	red algae	10%	0%	0%	0%	0.025	0.043	sand/gravel	28			-26.3
300	*Laminaria*	20%	10%	25%	20%	0.188	0.054	sand/gravel	28			-26.3
320	*Laminaria*	0%	15%	40%	30%	0.213	0.152	sand/gravel	28			-26.4
320	red algae	10%	<5%	0%	5%	0.038	0.041	sand/gravel	28			-26.4
340	red algae	15%	0%	15%	0%	0.075	0.075	sand	28			-26.5
340	*Laminaria*	10%	30%	40%	15%	0.238	0.119	sand	28			-26.5
360	red algae	10%	5%	5%	25%	0.113	0.082	sand/gravel	31			-29.6
360	*Laminaria*	15%	35%	90%	35%	0.438	0.279	sand/gravel	31		~13:00	-29.6

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 08/01/99

Transect#: S3
Visibility:
Location: 100' S of pier centerline
Heading: 110

Compass Declination: 0
Surveyor: A. Wones

Project: King County / Maury Island Gravel Mine

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0		0	0	0	0	0	0					
20		0	0	0	0	0	0					
40		0	0	0	0	0	0					
60		0	0	0	0	0	0					
80		0	0	0	0	0	0					
100		0	0	0	0	0	0					
120		0	0	0	0	0	0					
140		0	0	0	0	0	0					
160		0	0	0	0	0	0					
177		0	0	0	0	0	0	sand/gravel	2.3		14:35	-1.9
197		0	0	0	0	0	0	sand	4.5		14:38	-4.1
217		0	0	0	0	0	0	sand/gravel	12		14:40	-11.6
237	*Ulva*	1%	1%	2%	1%	0.013	0.004	sand/gravel	23		14:44	-22.6
257	*Ulva*	10%	0%	10%	0%	0.05	0.05	fine sand	31		14:47	-30.6
257	*Laminaria*	0%	0%	25%	80%	0.263	0.327	fine sand	31		14:47	-30.6
257	red alga	0%	15%	0%	0%	0.038	0.065	fine sand	31		14:47	-30.6

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 08/01/99

Transect#: S4
Visibility:
Location: 150' S of pier centerline
Heading: 110

Compass Declination: 0
Surveyor: G. Volkhardt

Project: King County / Maury Island Gravel Mine

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0		0	0	0	0	0	0					
20		0	0	0	0	0	0					
40		0	0	0	0	0	0					
60		0	0	0	0	0	0					
80		0	0	0	0	0	0					
100		0	0	0	0	0	0					
120		0	0	0	0	0	0					
140		0	0	0	0	0	0	sand	2		12:07	1.1
160		0	0	0	0	0	0	sand	3			-0.1
180		0	0	0	0	0	0	sand	4			-1.1
200	slope change	0	0	0	0	0	0	sand	6			-3.2
208	Eelgrass (1/4 m2 patch)	12	0	0	0	3	5.196	sand	10			-7.3
220	*Ulva*	<5%	<5%	<5%	<5%	0	0	sand	17			-14.4
240	*Ulva*	10%	10%	10%	10%	0.1	0	sand	26			-23.5
260	*Ulva*	15%	10%	25%	10%	0.15	0.061	sand	32			-29.6
280	*Laminaria*	0%	40%	0%	20%	0.15	0.166	sand	38			-35.7
280	*Ulva*	5%	10%	5%	10%	0.075	0.025	sand	38			-35.7

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 08/01/99

Transect#: S5
Visibility:
Location: 200' S of pier centerline
Heading: 110

Compass Declination: 0
Surveyor: A. Wones

Project: King County / Maury Island Gravel Mine

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	Headland	0	0	0	0	0	0	sand				
20	start of gravel/cobble	0	0	0	0	0	0	sand/cobble				
40		0	0	0	0	0	0	sand/cobble				
60	root wad w/ barnacles	0	0	0	0	0	0	sand/cobble				
80		0	0	0	0	0	0	sand	0.2		11:02	
94	change in substrate	0	0	0	0	0	0	sand/gravel				
100		0	0	0	0	0	0	sand/gravel				
120	*Ulva*	0	0	0	5%	0.013	0.022	sand	1.1		11:56	2.4
140	*Ulva*	1%	0%	1%	1%	0.008	0.004	sand/gravel	1.2		12:03	2.0
157	*Ulva*	5%	25%	15%	20%	0.163	0.074	sand/gravel	3.6		12:05	-0.5
160	*Ulva*	0%	1%	1%	1%	0.008	0.004	sand/gravel	3.9		12:07	-0.9
180		0	0	0	0	0	0	sand	5		12:09	-2.1
200	*Ulva*	0%	1%	1%	1%	0.008	0.004	sand	9		12:11	-6.1
210	Ulva; slope break	5%	1%	0%	1%	0.018	0.019	sand	10		12:14	-7.2
220	*Ulva*	0%	1%	1%	0%	0.005	0.005	sand	13		12:17	-10.3
240		0	0	0	0	0	0	sand/silt	21		12:19	-18.4
260		0	0	0	0	0	0	wood bits/sand	30		12:21	-27.4
270	*Laminaria*	0%	10%	0%	0%	0.025	0.043	wood bits/sand	35		12:23	-32.5

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 08/01/99

Transect#: S6
Visibility:
Location: 250' S of pier centerline
Heading: 110

Compass Declination: 0
Surveyor:G. Volkhardt, A. Wones

Project: King County / Maury Island Gravel Mine

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0		0	0	0	0	0	0					
20		0	0	0	0	0	0					
40		0	0	0	0	0	0					
60		0	0	0	0	0	0					
80		0	0	0	0	0	0	sand	2			4.3
100		0	0	0	0	0	0	sand	3		10:35	3.3
120		0	0	0	0	0	0	sand	4		~10:38	2.2
140		0	0	0	0	0	0	sand	6		~10:40	0.1
160		0	0	0	0	0	0	sand	7		~10:45	-1.1
164	eelgrass (1/4 m2 patch)	9	0	0	0	2.25	3.897	sand	7		~10:45	-1.1
180		0	0	0	0	0	0	sand	8		~10:50	-2.2
204	eelgrass	0	0	0	2	0.5	0.866	sand	10		~10:55	-4.4
220	eelgrass	26	47	21	24	29.5	10.26	sand	12		~11:00	-6.6
220	*Laminaria*	20%	10%	70%	50%	0.375	0.238	sand	12		~11:00	-6.6
220	*Ulva*	20%	10%	10%	10%	0.125	0.043	sand	12		~11:00	-6.6
240	eelgrass	13	31	20	3	16.75	10.21	sand	14		~11:05	-8.7
240	*Ulva*	5%	0%	0%	0%	0.013	0.022	sand	14		~11:05	-8.7
240	red alga	20%	0%	0%	0%	0.05	0.087	sand	14		~11:05	-8.7
258	end of eelgrass bed	9	12	1	7	7.25	4.023	sand	20		11:26	-15.5
261		0	0	0	0	0	0	sand	20.5		11:28	-16.1
280	*Ulva*	0	0	0	5%	0.013	0.022	sand	29.5		11:29	-25.1
300		0	0	0	0	0	0	sand	33		11:31	-28.6

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 08/01/99

Transect#: S7
Visibility:
Location: 300' S of pier centerline
Heading: 110

Compass Declination: 0
Surveyor: A. Wones

Project: King County / Maury Island Gravel Mine

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	headland	0	0	0	0	0	0	sand				
18		0	0	0	0	0	0	sand/gravel				
20		0	0	0	0	0	0	d / cobble / gravel				
30-36	boulder	0	0	0	0	0	0	d / cobble / gravel				
40		0	0	0	0	0	0	cobble/sand				
60		0	0	0	0	0	0	cobble/sand				
71		0	0	0	0	0	0	sand				
80		0	0	0	0	0	0	sand	2.7		10:03	4.7
100		0	0	0	0	0	0	sand/pea gravel	3.9		10:05	3.4
120		0	0	0	0	0	0	sand	8		10:08	-0.8
140	*Ulva*	1%	0%	0%	0%	0.003	0.004	sand	9		10:09	-1.9
160	*Ulva*	1%	0%	1%	0%	0.005	0.005	sand	10		10:13	-3.0
170	worm tubes	0	0	0	0	0	0	sand	10.5		10:14	-3.5
180		0	0	0	0	0	0	sand	11		10:15	-4.0
200		0	0	0	0	0	0	sand	12		10:18	-5.1
208	eelgrass (south edge)	17	20	17	0	13.5	7.89	sand	12		10:22	-5.3
214	end of eelgrass bed	26	21	18	18	20.75	3.269	sand	18		10:30	-11.5
220		0	0	0	0	0	0	sand	19		10:32	-12.6
235	*Laminaria*	100%	100%	100%	100%	1	0	sand/silt	22		10:33	-15.6
243	*Laminaria*	50%	20%	50%	70%	0.475	0.179	sand/silt	23		10:35	-16.7
250	*Ulva*	5%	1%	5%	0%	0.028	0.023					
250	red alga	5%	1%	0%	10%	0.04	0.039	sand/silt	25		10:37	-18.8
260	*Laminaria*	0%	0%	0%	40%	0.1	0.173	sand/silt	28		10:40	-21.9
260	*Ulva*	0%	0%	5%	0%	0.013	0.022					
280		0	0	0	0	0	0	sand	31		10:44	-25.1
281	piling horizontal on substrate	0	0	0	0	0	0	sand	32		10:45	-26.1

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 08/01/99

Transect#: S8
Visibility:
Location: 350' S of pier centerline
Heading: 110

Compass Declination: 0
Surveyor: G. Volkhardt

Project: King County / Maury Island Gravel Mine

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	Headland	0	0	0	0	0	0					
20		0	0	0	0	0	0					
40		0	0	0	0	0	0					
60		0	0	0	0	0	0					
80	*Ulva*	5%	5%	0%	0%	0.025	0.025	sand	3		09:43	5.0
100		0	0	0	0	0	0	sand	3		~09:46	5.0
120		0	0	0	0	0	0	sand	5		~09:49	2.8
140	*Ulva*	5%	10%	5%	0%	0.05	0.035	sand	7		~09:52	0.8
160	*Ulva*	5%	5%	5%	10%	0.063	0.022	sand	8		~09:55	-0.4
180	*Ulva*	<5%	<5%	<5%	<5%	0	0	sand	9		~09:58	-1.5
200	*Ulva; slope break*	<5%	<5%	<5%	<5%	0	0	sand	12		~10:00	-4.6
220		0	0	0	0	0	0	sand	20		~10:03	-12.6
240	*Ulva*	0%	10%	15%	10%	0.088	0.054	sand	28		~10:06	-20.7
260	*Laminaria*	0%	30%	5%	0%	0.088	0.124	sand	35		~10:10	-27.9
260	*Ulva*	5%	20%	5%	10%	0.1	0.061	sand	35		~10:10	-27.9
280	red algae	0%	5%	0%	5%	0.025	0.025	sand	38		~10:13	-31.0
280	*Ulva*	5%	15%	30%	20%	0.175	0.09	sand	38		~10:13	-31.0
280	*Laminaria*	0%	0%	30%	0%	0.075	0.13	sand	38		~10:13	-31.0

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 08/01/99

Transect#: S9
Visibility:
Location: 350' S of pier centerline
Heading: 110

Compass Declination: 0
Surveyor: G. Volkhardt

Project: King County / Maury Island Gravel Mine

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	Headland	0	0	0	0	0	0					
20		0	0	0	0	0	0					
40		0	0	0	0	0	0					
60		0	0	0	0	0	0					
80		0	0	0	0	0	0					
100		0	0	0	0	0	0					
120		0	0	0	0	0	0					
140		0	0	0	0	0	0					
160		0	0	0	0	0	0					
180	*Enteromorpha*	<5%	5%	0%	5%	0.025	0.025	sand	2		14:34	-1.6
200	*Enteromorpha; slope break*	<5%	5%	<5%	<5%	0.013	0.022	sand	3		~14:36	-2.6
220		0	0	0	0	0	0	sand	11		~14:38	-10.6
230	1 eelgrass turion	1	0	0	0	0.25	0.433	sand	15		~14:40	-14.6
240	*Ulva*	20%	10%	5%	40%	0.188	0.134	sand	19		~14:42	-18.6
260	*Ulva*	20%	60%	20%	5%	0.263	0.204	sand	27		~14:44	-26.6
260	*Laminaria*	60%	0%	40%	70%	0.425	0.268	sand	27		~14:45	-26.6
280	*Ulva*	20%	10%	5%	10%	0.113	0.054	sand	33		14:47	-32.5

Comments: base of southernmost dolphin 42'
* Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.
Eelgrass patch12' south of transect at between 212' and 219' (7')

Intensive Eelgrass / Macroalgae Survey Form

Date: 08/01/99

Transect#: C1
Visibility:
Location: 600' N of pier centerline
Heading: 110

Compass Declination: 0
Surveyor: A. Wones

Project: King County / Maury Island Gravel Mine

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	headland	0	0	0	0	0	0	sand				
13	cobble band begins	0	0	0	0	0	0	cobble/sand				
20		0	0	0	0	0	0	cobble/sand				
40		0	0	0	0	0	0	cobble/sand				
60		0	0	0	0	0	0	cobble/sand				
80	barnacles; Enteromorpha	10%	20%	20%	10%	0.15	0.05	cobble/sand				
100		0	0	0	0	0	0	sand				
120		0	0	0	0	0	0	sand	2		16:29	1.4
140	*Enteromorpha*	0%	0%	1%	0%	0.003	0.004	sand	3		16:32	0.5
160		0	0	0	0	0	0	sand	4		16:36	-0.5
180	diatoms	0	0	0	0	0	0	sand	8		16:38	-4.4
195	eelgrass	25	27	35	21	27	5.099	sand	10		16:42	-6.2
210	end of eelgrass	27	17	18	13	18.75	5.117	sand	10.5		16:47	-6.5
213		0	0	0	0	0	0	sand	10.5		16:48	-6.4
220		0	0	0	0	0	0	sand	11		16:51	-6.8
233	eelgrass	3	8	22	18	12.75	7.595	sand	11		16:55	-6.6
253	eelgrass	28	25	24	26	25.75	1.479	sand	13		17:04	-8.2
253	*Laminaria*	28%	0%	0%	0%	0.07	0.121	sand	13			
273	eelgrass	17	24	9	13	15.75	5.54	sand	18		17:03	-13.3
273	*Laminaria*	25%	0%	0%	0%	0.063	0.108	sand	18			
293	eelgrass	12	2	8	6	7	3.606	sand	20		17:07	-15.1
293	*Ulva*	10%	0%	15%	0%	0.063	0.065	sand	20		17:07	-15.1
304	end of eelgrass	2	0	0	0	0.5	0.866	sand	21		17:10	-15.9
304	*Ulva*	10%	0%	0%	20%	0.075	0.083	sand	21		17:10	-15.9
304	*Laminaria*	0%	25%	0%	10%	0.088	0.102	sand	21		17:10	-15.9
320	*Laminaria*	0%	25%	30%	0%	0.138	0.139	sand	26		17:12	-20.8
340	*Laminaria*	20%	50%	15%	40%	0.313	0.143	sand	30		17:14	-24.7
340	red alga	5%	0%	0%	0%	0.013	0.022	sand	30		17:14	-24.7
360		0	0	0	0	0	0	sand	33		17:15	-27.7
>360	*Laminaria*							sand	>33		17:15	<-28

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 08/01/99

Transect#: C2
Visibility:
Location: 650' N of pier centerline
Heading: 110

Compass Declination: 0
Surveyor: G. Volkhardt

Project: King County / Maury Island Gravel Mine

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	headland	0	0	0	0	0	0	sand				
20		0	0	0	0	0	0	sand				
24		0	0	0	0	0	0	gravel				
40		0	0	0	0	0	0	gravel				
51	*Enteromorpha*	30%	0%	0%	10%	0.1	0.122	gravel				
60	*Enteromorpha*	25%	20%	40%	15%	0.25	0.094	gravel				
80	*Enteromorpha*	30%	5%	10%	30%	0.188	0.114	sand/gravel				
100	*Enteromorpha*	40%	30%	20%	30%	0.3	0.071	sand				
120	*Ulva*	20%	5%	10%	10%	0.113	0.054	sand	3		16:47	1.1
140		0	0	0	0	0	0	sand	4		~16:50	0.2
160		0	0	0	0	0	0	sand				
175	eelgrass	10	0	0	40	12.5	16.39	sand	7			-2.7
181	eelgrass - end of bed	7	3	0	0	2.5	2.872	sand	8		~16:55	-3.6
197	eelgrass	5	40	19	0	16	15.51	sand	10			-5.5
200	eelgrass	45	34	41	0	30	17.76	sand	10		~17:00	-5.4
220	eelgrass	8	0	0	0	2	3.464	sand	15			-10.3
240	eelgrass	10	17	20	7	13.5	5.22	sand	15		~17:05	-10.2
260	eelgrass	0	16	13	3	8	6.671	sand	16			-11.1
260	*Ulva*	0%	0%	20%	0%	0.05	0.087	sand	16		~17:10	-10.9
260	*Laminaria*	60%	75%	40%	80%	0.638	0.156	sand	16			-10.8
280	eelgrass	11	18	17	21	16.75	3.631	sand	18		~17:15	-12.7
295	eelgrass - end of bed	0	3	5	0	2	2.121	sand	20			-14.6
320	*Laminaria*	40%	95%	100%	70%	0.763	0.238	sand	25		~17:20	-19.5
340	*Laminaria*	100%	100%	70%	75%	0.863	0.139	sand	29			-23.4
360	*Laminaria*	100%	100%	100%	80%	0.95	0.087	sand	34		~17:25	-28.2

Comments: * Tidal elevations corrected using an average between tide predictions for Tahlequah and Des Moines. Generally the difference between these stations is less than 0.3 feet.

Intensive Eelgrass / Macroalgae Survey Form

Date: 08/01/99

Transect#: C3
Visibility:
Location: 700' N of pier centerline
Heading: 110

Compass Declination: 0
Surveyor: G. Volkhardt

Project: King County / Maury Island Gravel Mine

Eelgrass Density/ 0.25 m2
Macroalgae % cover

Distance (feet)	Observation	R1	R2	R3	R4	Ave.	Std.	Substrate	Measured Depth (ft)	Measured Elevation (ft)	Time	Tidal Elevation* (ft)
0	headland	0	0	0	0	0	0	sand				
20		0	0	0	0	0	0	gravel				
40		0	0	0	0	0	0	gravel				
60	*Enteromorpha*	30%	0%	0%	0%	0.075	0.13	gravel				
70		0	0	0	0	0	0	sand				
80	*Ulva*	10%	35%	25%	0%	0.175	0.135	sand				
100		0	0	0	0	0	0	sand				
120	*Ulva*	10%	35%	25%	0%	0.175	0.135	sand	2		16:30	1.4
140		0	0	0	0	0	0	sand	3		16:35	0.6
>140	no eelgrass on transect	0	0	0	0	0	0	sand				0 to <-16

Comments: